WHAT IS CLAIMED IS:

1. A method of wavelength converting a plurality of optical signal channels that span a frequency bandwidth, said method comprising:

four-wave mixing said optical signal channels and an pump lightwave in a conversion medium; and

selecting a frequency for said pump lightwave such that the frequency difference between any selected optical signal channel frequency and the pump lightwave frequency is approximately equal to or greater than the frequency bandwidth spanned by the plurality of optical signal channels.

2. The method of Claim 1, wherein said frequency of said pump lightwave is selected to be approximately equal to a zero dispersion frequency of said conversion medium.

3. The method of Claim 1, wherein said conversion medium exhibits a non-linear optical property.

4. A method of wavelength conversion of a plurality of optical signal channels spanning a frequency bandwidth, said method comprising:

four-wave mixing, in a conversion medium, said plurality of optical signal channels and first and second pump lightwaves having first and second frequencies respectively;

selecting frequencies for said first and second pump lightwaves such that (1) the optical signal channel frequencies lie between said first pump lightwave frequency and an average frequency of said two pump lightwave frequencies, and (2) the frequency difference between said first and second pump frequencies is at least about four times the frequency span of said optical signal channels.

5. The method of Claim 4, wherein said average frequencies of pump lightwaves is approximately equal to a zero dispersion frequency of said conversion medium.

6. The method of Claim 4, wherein said conversion medium exhibits a non-linear optical property.

7. A wavelength converter comprising:

a demultiplexer, configured to demultiplex a wavelength division multiplexed (WDM) optical signal into at least two demultiplexed WDM optical signals, wherein

a first demultiplexed WDM optical signal has a first frequency bandwidth and a second demultiplexed WDM optical signal has a second frequency bandwidth;

a first wavelength converting section comprising a first conversion medium configured to receive said first demultiplexed WDM optical signal and an pump lightwave, wherein there is an interval between a said frequency of said pump lightwave and one frequency of said demultiplexed WDM optical signal with a frequency closest to said frequency of said pump lightwave. and said interval between said pump lightwave and said first demultiplexed WDM optical signal is equal to or greater than said first frequency bandwidth of said first demultiplexed WDM optical signal, and wherein a first output signal, including a first wavelength converted WDM optical signal, is produced at an output of said first wavelength converting section;

a second wavelength converting section comprising a second conversion medium configured to receive said second demultiplexed WDM optical signal and a first and second pump lightwaves, wherein said second demultiplexed WDM optical signal is in a frequency bandwidth between a frequency of said first pump lightwave and an average frequency of said first and second pump lightwaves, wherein a frequency bandwidth between said first frequency of said first pump lightwave and said second demultiplexed WDM optical signal with a frequency closest to said first pump lightwave is set equal to or greater than said frequency bandwidth of said second demultiplexed WDM optical signal, and wherein a second output signal, including a second wavelength converted WDM optical signal, is produced at an output of said second wavelength converting section;

a first filter, coupled to said first wavelength converting section, configured to receive said first output signal and to pass only said first wavelength converted WDM optical signal;

a second filter, coupled to said second wavelength converting section, configured to receive said second output signal and to pass only said second wavelength converted WDM optical signal; and

a multiplexer, coupled to said first filter and said second filter, configured to multiplex said first wavelength converted WDM optical signal from said first filter and said second wavelength converted WDM optical signal from said second filter.

8. The wavelength converter of Claim 7, wherein said frequency of said pump lightwave in said first wavelength converting section is equal to a zero dispersion frequency of said first conversion medium.

9. The wavelength converter of Claim 7, wherein said average frequency of said two pump lightwaves in said second wavelength converting section is equal to a zero dispersion frequency of said second conversion medium.

10. An apparatus for producing wavelength converted light comprising a conversion medium coupled to receive as inputs a wavelength division multiplexed (WDM) optical signal and a pump lightwave, wherein the WDM optical signal has a bandwidth WBW, and wherein the frequency of said pump lightwave is at least WBW different from the frequencies present in the WDM optical signal.

11. The apparatus of Claim 10, wherein said conversion medium comprises a high-nonlinearity optical fiber.

12. The apparatus of Claim 10, wherein said conversion medium comprises a dispersion shifted optical fiber.

13. The apparatus of Claim 10, wherein the pump light source has a frequency that is at least WBW greater than the highest signal channel frequency.

14. The apparatus of Claim 10, wherein the pump light source has a frequency that is at least WBW smaller than the lowest signal channel frequency.

15. A method of wavelength converting an optical signal having a bandwidth WBW, the method comprising injecting a pump lightwave into a conversion medium with said optical signal, wherein said pump lightwave has a frequency that is spaced by at least WBW from a closest frequency channel in said optical signal.

16. The apparatus of Claim 15, wherein said conversion medium comprises a high-nonlinearity optical fiber.

17. The apparatus of Claim 15, wherein said conversion medium comprises a dispersion shifted optical fiber.

18. A method of wavelength converting a wavelength division multiplexed (WDM) optical signal having a bandwidth WBW, the method comprising injecting first and second pump lightwaves into a conversion medium with said WDM optical signal, wherein (1) said first pump lightwave has a frequency at least WBW less than the lowest frequency in said WDM optical signal, (2) the average frequency of said first and second pump lightwaves is higher than the highest frequency in said WDM optical signal, and (3) said second pump lightwave has a frequency at least 2WBW greater than an average frequency of said first and second pump lightwaves.

19. A method of wavelength converting WDM optical signal having a bandwidth WBW, the method comprising injecting first and second pump lightwaves into a conversion medium with said WDM optical signal, wherein (1) said first pump lightwave has a frequency at least 2WBW less than said average frequency of said first and second pump lightwaves, (2) said average frequency of said first and second pump lightwaves is less than the lowest frequency in said WDM optical signal, and (3) said second pump lightwave has a frequency at least WBW grater than the highest frequency in said WDM optical signal.

20. A method of wavelength converting an optical signal, comprising combining one or more pump lightwaves with said WDM optical signal in a conversion medium, and producing a converted output WDM optical signal spanning a frequency band outside of a frequency band that contains noise signals produced by improper four-wave mixing in said conversion medium.

21. The method of Claim 19 or 20, comprising combining said optical signal with a single pump lightwave.

22. The method of Claim 21 comprising providing a guard band around said pump lightwave.

23. The method of Claim 19 or 20, comprising combining said optical signal with at least two pump lightwaves.

24. The method of Claim 23, comprising providing a guard band around all of said pump lightwaves.

25. The method of Claim 19 or 20, comprising separating the frequencies present in said optical signal from the frequencies present in said pump lightwaves by an amount sufficient to separate noise frequencies from converted output signal frequencies.

26. A system for wavelength conversion of an optical signal comprising:

a conversion medium;

an optical signal input to said conversion medium;

at least one pump light source input to said conversion medium;

a converted optical signal output from said conversion medium; and

means for preventing noise produced by improper four wave mixing from appearing in a frequency band occupies by said converted optical signal.

27. The system of Claim 26, wherein said means comprises a guard band surrounding said at least one pump source.

28. A wavelength converter for converting the wavelength of a signal light, comprising:

a first branch having a single pump source; and

a second branch having a plurality of pump sources.

29. The converter of Claim 28, wherein said single pump source in said first branch has a frequency that is either higher or lower than all of the signal light frequencies.

30. The converter of Claim 29, wherein a first of said plurality of said pump light sources in said second branch has a frequency higher than at least some of the signal light and a second pump light source has a frequency lower than at least some of the signal light.

31. A multifrequency light source comprising:

N light sources;

a multiplexer having said N light sources as an input and a multiplexed output; and

a wavelength converter having said multiplexed output as an input and having 2N optical signal outputs.

32. The light source of Claim 31, additionally comprising a demultiplexer receiving an output of said wavelength converter as an input.

33. The light source of Claim 31, wherein said light sources comprise photodiodes.